MATH 122 B, Spring 2019: Calculus II

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Class Meetings

Mondays, Wednesdays, Fridays: 12:00 PM - 1:00 PM in Trexler 374
Thursdays (Lab): 8:30 AM - 10:00 AM in Trexler 372

Office Hours

In an effort to be more available to students while also acknowledging that meetings occur in my schedule that are outside of my direct control, rather than specify office hours specifically, I have chosen to use the "You Can Book Me" online scheduling tool so that you can schedule an appointment whenever, and your appointment will be put on my schedule (this online tool uses my live availability). Note that I am *generally* on campus all weekdays from 9 AM to 2 PM and you are still welcome to stop by without an appointment, but I may or may not be able to meet at any given time. You can access the online scheduler at:

- drtaylorofficehours.youcanbook.me

Course Objectives

This course provides a continuation of the study of calculus. Topics to be studied include more applications of the definite integral, sequences and series and applications of them, and vectors and functions of one variable.

Intended Learning Outcomes

By the end of this course, successful students will be able to:

- apply the theory of differentiation and integration to model and solve real-world problems.
- recognize a differential equation and be able to both solve basic differential equations and discuss what a differential equation tells you about the process it models.
- determine the behavior of infinite series and understand the role of power series and Taylor series in modern mathematics.
- utilize vectors in two-dimensional and higher-dimensional coordinate systems to model graphs and equations, and apply methods of Calculus to these graphs and equations.
- recognize the role of technology in Calculus, understand when it should be used, and be aware of its limitations.

Required Materials

Textbook: *Calculus: Early Transcendental Functions*, by Smith and Minton, 4th Edition
Lab Technology: Laptop with Mathematica installed
Mathematica Free Download: see https://webapps.roanoke.edu/www/it/mathematica/
Calculator: A calculator with graphing capabilities
Prerequisite: MATH 121 (Calculus I) or the equivalent

Commitment Hours

This course expects you to spend at least 12 hours of work each week inside and outside of class.

Course Grades

The following table lists the weights for the various forms of assessment for this class.

Homework	13%	Labs & Recitations	12%	Mastery Exams	75%

A grade scale will be determined after final grades are computed, but will be no worse than the scale given below:

		B+	87-89	C+	77-79	D+	67-69		
A	93-100	B	83-86	C	73-76	D	63-66	F	0-59
A-	90-92	B-	80-82	C-	70-72	D-	60-62		

Reading

The key to learning a topic in mathematics is participation. We will strive to have an active, rather than passive, classroom environment. Near the end of the syllabus is a day-by-day outline of the sections that will be discussed in class. You are fully expected to have read the upcoming section before the class meeting! This does not mean you need to understand everything, but rather you should be familiar with the definitions and concepts from the sections. You should also reread the section *after* class so that you can clarify topics from class and help prepare you further.

Exams

We will be making use of "Mastery-Based Examination," a system that is probably very different from what you are used to; do not hesitate to ask me questions in class or my office at any time. In the mathematics community many are working with and researching this technique, and one of the best starting sources for understanding can be found at https://mbtmath.wordpress.com. Much of what you'll find on this syllabus is taken from this resource.

Short Description: You only receive credit for answers that demonstrate you completely understand (have mastered) a topic. But, you get many chances to display mastery throughout the semester with no penalty at all for earlier attempts.

Long Description: The course has been boiled down to 22 essential types of questions, or "topics," and your mastery of questions on these topics is assessed through four mastery testing days, smaller mastery testing opportunities between testing days, and the final exam periods. Each problem submitted is graded as either "mastered" or "not mastered" and a grade of "mastered" indicates that you have demonstrated full understanding of the concept being tested and further work on the topic is not necessary. Once you have mastered a problem you need not ever attempt it again on a future exam, including the final exam. There is no penalty whatsoever for multiple attempts taken to achieve mastery.

Your overall exam grade is then determined by the number of topics you have mastered throughout the semester; see below for more about how the number of topics translates to a grade for the exam portion of the class and what the topics are!

Why such a different examination policy? A typical policy that has four tests on which material on test 1 is not revisited until the final exam promotes a "fixed mindset" mentality and does not encourage growth in learning; allowing multiple attempts to achieve mastery on a single topic is a "growth mindset" – we firmly believe that you can all do this! It may just take some of you a little longer or shorter for certain topics. Rather than thinking "I can't do this" you should be thinking "I can't do this, yet" and work towards getting it done.

Notes on Mastery-Based Examination (in no specific order, credit to Austin Mohr):

- Clear content objectives, students continually know exactly what they need to work on to improve.
- Credit only for eventual mastery. No partial credit.
- Multiple attempts with complete forgiveness.
- A points-based system sets arbitrary deadlines by which time perfection must be attained or else penalties apply.
- Perseverance:
  - Points: Try a problem once, maybe twice, hope for the best.
  - Mastery: Keep trying until you succeed (and I know you can).
- Use of feedback on exams:

  - Points: Do you agree with the instructor's grading?
  - Mastery: What can I do to fully demonstrate that I understand the concept (improvement!)?
- Reduced Anxiety:
  - Points: Every exam has the potential to damage your GPA.
  - Mastery: No one exam can harm your grade.
- Intelligent Test Preparation: You may actually choose to skip problems on a test. Better to achieve mastery on some than to demonstrate mediocrity on all. Given time constraints of the latter tests, most students will only be able to focus on 5-8 problems in 90 minutes.
- Formative Assessment:
  - Points: How many points is this error worth?
  - Mastery: Will the student benefit from studying the concept again?
- No longer will any of us have to wonder just what exactly a 7/10 means on a problem compared to an 8/10.
- In most points-based systems, a blank exam question is a heavy blow to a student's grade. On the other hand, a student who provides a couple relevant formulas and something resembling the beginning of a solution may receive half credit or more. In the presence of constrained study time, a good strategy is to learn some basics about every test item. Such a student may earn half credit on most items together with a few lucky shots on easier items, which amounts to a passing grade overall. Take a moment to consider whether this experience has adequately prepared the student to apply mathematical thinking to nontrivial problems in the future.

The "broad and superficial" strategy employed above earns no credit under a masterybased system. Instead, a student who wishes to earn a passing exam grade must fully understand an appreciable subset of the main ideas of the course, and a student wishing to earn an A grade must fully understand most or all of the main ideas of the course. Even if students spend no time studying a particular item, we contend that the experience of pursuing deep understanding on the other items leaves them in a stronger position to engage deeply with the troublesome topic when it is needed in the future. Moreover, depth of understanding is critical to one's ability to apply existing mathematical knowledge in novel domains.

There are four mastery days listed on the day-by-day schedule part of this syllabus. On these days, you will have the opportunity to attain mastery in any of the topics we have covered up to that date. There are also four mini-mastery days listed on the schedule, and on these days, we will use 30 minutes during a regular class period so that you can attempt mastery in up to two topics of your choice; you must contact the instructor prior 9 AM the day of a mini-mastery attempt with your choice of topics to attempt. Finally, you will have two opportunities during the final exam week in order to achieve mastery.

The exam portion of your course grade will be based on the number of topics mastered; here is a conversion of the number mastered to a percentage for the exam portion of the grade.

Topics Mastered	22	21	20	19	18	17	16	15	14	13	12
Exam Percentage	100	97	94	91	88	85	82	79	76	72	68
Topics Mastered	11	10	9	8	7	6	5	4	3	2	1

Exam Percentage	64	60	55	50	45	40	35	30	20	10	0

Homework

A problem set will be assigned for virtually all sections that we cover; each problem set will consist of 2 required problems and a number of practice problems. Note that the required problems will not be from the textbook and will instead be posted on Inquire. The required problems will be graded for correctness and presentation (3 points for correctness and 2 points for presentation) for a total of 10 points. You are encouraged to do and submit as many of the practice problems as you would like, and the instructor will provide feedback on those problems. When you turn in your problem set, the 3 required problems should all be first, and in order as they appear in the textbook. Your homework should be neat, organized, and stapled!

In the spirit of mastery-based testing, these problem sets do not have a due date. However, you may not turn in or received credit for a problem set after you have received mastery for the topic or topics that correspond to that problem set. Note that you are encouraged to collaborate on problems sets, but you must **write up your own solution**. If you are looking at another person's work or asking someone what to do next while writing up your problem set, then you are in violation of the academic integrity policy of Roanoke College.

Quizzes

There may be written quizzes in this class. They may either be in-class quizzes or takehome quizzes. I may occasionally warn you about an upcoming quiz but you should be prepared to take a quiz on any given day, including lab days. These quizzes will count as a homework assignment.

Labs

We will meet in Trexler 372 every Thursday from 8:30 AM to 10:00 AM. This time will mostly be spent working in groups on various problems. Some days will be Lab days, in which you will work on interesting applications of the calculus we are studying and use Mathematica to help you in this process. Other days will be Recitation days, led by your student lab leaders, in which you will focus on working problems to help solidify concepts from class. Other Thursdays will be Mastery days, which will allow you more time than during regular class time. Lab and Recitation days are more informal and should be **noisy**. Ask questions of lab leaders and classmates!

(1) Be on time! (2) Bring laptop, writing utensil, paper, textbook, notes.
(3) Learn Mathematica! (4) Think! (5) Work with others!

Final Exam

Since this class has regular meetings during block 4 and lab time on Thursdays during block 9, we have two days on which to have our "final exam." Of course, if you have mastered all of the topics for the class (or all of the topics you wish to master), you need not show up for either final exam slot! That said, you will have the opportunity to master topics on **Wednesday, April 24 from 8:30 AM to 11:30 AM** and on **Friday, April 26 from 8:30 AM to 11:30 AM**.

Attendance & Make-Up Work

Attendance is critical to the understanding of the material in the course; it is both required and expected. Any absence that is not discussed with the instructor prior to the missed class is considered unexcused. When absent, excused or unexcused, you are responsible for all material covered in class. **You will not be allowed to make up any work missed due to an unexcused absence.** Should you miss a class or part of a class, email or talk to me as soon as possible to see if anything can be done to help you catch up.

MCSP Conversation Series

The Department of Mathematics, Computer Science and Physics offers a series of discussions that appeal to a broad range of interests related to these fields of study. These co-curricular sessions will engage the community to think about ongoing research, novel applications and other issues that face our discipline. Members of this class are invited be involved with all of these meetings; however participation in **at least two** of these sessions is mandatory. After attending, students will submit a one page paper reflecting on the discussion **within a week of attending the talk**. This should **not** simply be a regurgitation of the content, but rather a personal contemplation of the experience. These reaction papers will be counted as homework and should be uploaded to Inquire using the appropriate link.

Academic Integrity

Students are expected to adhere to the Academic Integrity policies of Roanoke College. All work submitted for a grade is to be your own work! No electronic devices other than calculators can be taken out during any class or testing period (this includes cell phones) unless written consent is given by the professor (e.g. Mathematica may be allowed for some tests). Note that looking at or using your cell phone during a test or quiz is considered a violation of Academic Integrity regardless of your purpose or intent in doing so.

Subject Tutoring

Subject Tutoring, located on the lower level of Fintel Library (Room 5), is open 4:00 PM - 9:00 PM, Sunday - Thursday. We are a Level II Internationally Certified Training Center through the College Reading and Learning Association (CRLA). Subject Tutors are highly trained Roanoke College students who offer one-on-one tutorials in a variety of general education and major courses such as: Business, Economics, Mathematics, INQ 240, Modern Languages, Lab Sciences, INQ 250, and Social Sciences. Tutoring sessions are available in 15, 30, or 45-minute appointments. Feel free to drop by for a quick question or make an appointment at https://libguides.roanoke.edu/subject_tutoring for a longer one-on-one appointment. For questions or concerns, please contact us at 540-3752590 or subject_tutoring@roanoke.edu.

Mon	Jan 14	7.1	Introduction and Differential Equations
Wed	Jan 16		**No Class**
Thur	Jan 17		**No Lab**
Fri	Jan 18		**No Class**
Mon	Jan 21	7.1, 7.2	Differential Equations
Wed	Jan 23	5.5	Projectile Motion
Thur	Jan 24		**Lab 1: Intro to Mathematica**
Fri	Jan 25	5.6	Applications of Integration
Mon	Jan 28	5.6	Applications of Integration
Wed	Jan 30	5.7	Probability and **Mini-Mastery**
Thur	Jan 31		**Recitation**
Fri	Feb 1	5.7	Probability
Mon	Feb 4	10.1, 10.2	Vectors
Wed	Feb 6		**Review**
Thur	Feb 7		**Mastery Day**
Fri	Feb 8	10.3	Dot Product
Mon	Feb 11	10.4	Cross Product
Wed	Feb 13	10.5	Lines and Planes in Space
Thur	Feb 14		**Lab 2: Vectors**
Fri	Feb 15	10.5	Lines and Planes in Space
Mon	Feb 18	11.1	Vector-Valued Functions and **Mini-Mastery**
Wed	Feb 20	11.2	Calculus of Vector-Valued Functions
Thur	Feb 21		**Recitation**
Fri	Feb 22	11.3	Motion in Space
Mon	Feb 25	9.4	Polar Coordinates
Wed	Feb 27		**Review**
Thur	Feb 28		**Mastery Day**
Fri	Mar 1	9.1, 9.2	Parametric Equations
			Spring Break
Mon	Mar 11	8.1	Sequences
Wed	Mar 13	8.1, 8.2	Sequences and Series
Thur	Mar 14		**Recitation**
Fri	Mar 15	8.2	Series
Mon	Mar 18	8.2	Series and **Mini-Mastery**
Wed	Mar 20	8.5	Ratio Test
Thur	Mar 21		**Recitation**
Fri	Mar 22	8.5	Ratio Test
Mon	Mar 25	8.6	Power Series
Wed	Mar 27		**Review**

Tentative Schedule

Thur	Mar 28		**Mastery Day**
Fri	Mar 29	8.6	Power Series
Mon	Apr 1	8.7	Taylor Series
Wed	Apr 3	8.7	Taylor Series
Thur	Apr 4		**Lab 3: Series**
Fri	Apr 5	8.7	Applications of Taylor Series
Mon	Apr 8	8.8	Applications of Taylor Series and **Mini-Mastery**
Wed	Apr 10		**In-Class Lab: Hidden Figures**
Thur	Apr 11		**Recitation**
Fri	Apr 12		**Career Services**
Mon	Apr 15	8.9	Fourier Series
Wed	Apr 17		**Review**
Thur	Apr 18		**Mastery Day**
Fri	Apr 19		**No Class: Good Friday**
Wed	Apr 24		**Exam Block 8:30 AM – 11:30 AM: Mastery Day**
Fri	Apr 26		**Exam Block 8:30 AM – 11:30 AM: Mastery Day**

Topics

Topic Number	Name	Rough Textbook Alignment
1	Differential Equations: Modeling	7.1
2	Differential Equations: Solving	7.2
3	Projectile Motion: Basic	5.5
4	Integration: Physics	5.6
5	Integration: Probability	5.7
6	Vectors: Calculations, Basic	10.1, 10.2
7	Vectors: Calculations, Advanced	10.3, 10.4
8	Vectors: Applications	10.3, 10.4
9	Lines and Planes in Space	10.5
10	Vector-Valued Functions: Basic	11.1
11	Vector-Valued Functions: Calculus	11.12
12	Projectile Motion: Advanced	11.3
13	Polar Coordinates	9.4
14	Parametric Equations	9.1, 9.2
15	Sequences	8.1
16	Series: Core	8.2
17	Series: Ratio Test	8.5
18	Power Series	8.6
19	Taylor Series: Core	8.7
20	Taylor Series: Error	8.7
21	Taylor Series: Applications	8.8
22	Fourier Series	8.9